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Effects of Magnetization Patterns on Characteristics of Permanent Magnet Linear Synchronous Generator for Wave Energy Converter Applications

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Abstract : The rare earth magnets used in synchronous generators offer many advantages, including high efficiency, greatly reduced the size, and weight. The permanent magnet linear synchronous generator (PMLSG) allows for direct drive without the need for a mechanical device. Therefore, the PMLSG is well suited to translational applications, such as wave energy converters and free piston energy converters. This manuscript compares the effects of different magnetization patterns on the characteristics of double-sided PMLSGs in slotless stator structures. The Halbach array has a higher flux density in air-gap than the Vertical array, and the advantages of its performance and efficiency are widely known. To verify the advantage of Halbach array, we apply a finite element method (FEM) and analytical method. In general, a FEM and an analytical method are used in the electromagnetic analysis for determining model characteristics, and the FEM is preferable to magnetic field analysis. However, the FEM is often slow and inflexible. On the other hand, the analytical method requires little time and produces accurate analysis of the magnetic field. Therefore, the flux density in air-gap and the Back-EMF can be obtained by FEM. In addition, the results from the analytical method correspond well with the FEM results. The model of the Halbach array reveals less copper loss than the model of the Vertical array, because of the Halbach array's high output power density. The model of the Vertical array is lower core loss than the model of Halbach array, because of the lower flux density in air-gap. Therefore, the current density in the Vertical model is higher for identical power output. The completed manuscript will include the magnetic field characteristics and structural features of both models, comparing various results, and specific comparative analysis will be presented for the determination of the best model for application in a wave energy converting system.

Keywords : wave energy converter, permanent magnet linear synchronous generator, finite element method, analytical method
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